



INTRODUCTION OF FUNDAMENTAL MEDICAL PHYSICS AND MEASUREMENT

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FUNDEMANAL OF MEDICAL PHYSICS

spring semester

Week 1

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Outline

- Introduction of Fundamental Medical Physics and Measurement
- Therapeutic Heating Modalities

Objectives of 1st week lecture

The student should be able to do the followings;

- Explain the fundamental Medical Physics and Measurement
- Mention the therapeutic Heating Modalities

Medical Physics



Medical Physics is the application of physics to medicine.

It uses physics concepts and procedures in the prevention, diagnosis, treatment of disease, beside the measurement of ionizing radiation, magnetic resonance imaging, and the application of lasers, ultrasound, and other technologies which utilize physics concepts as applied to medicine.

Medical Physics includes areas such as 1- Radiotherapy physics, 2- Diagnostic Radiology physics, 3- Nuclear Medicine Physics, 4- Radiation Protection.

Physical Quantities and Units

- International System of Units (SI system)
- *The seven basic physical quantities*
- *Length l* meter (m)
- *Mass m* kilogram (kg)
- *Time t* second (s)
- *Electric current I* ampere (A)
- *Temperature T* kelvin (K)
- *Amount of substance* mole (mol)
- *Luminous intensity* candela (cd)

Physical quantity	Symbol	Units in SI
Length	l	m
Mass	m	kg
Time	t	s
Current	I	A
Temperature	T	K
Mass density	ρ	kg/m ³
Current density	j	A/m ²
Velocity	v	m/s
Acceleration	a	m/s ²
Frequency	ν	Hz
Electric charge	q	C
Force	F	N
Pressure	p	Pa
Momentum	p	N · s
Energy	E	J
Power	P	W



Classification of Forces in Nature



◦ Four types of forces are observed in the interaction between various types of particles.

1- ***strong nuclear force***: the strongest of all forces, it binds protons and neutrons together within an atomic nucleus, operating only at very short distance.

2- ***electromagnetic (EM) force***: acts between electrically charged particles, holding electrons around the nucleus and enabling electricity, magnetism, and light. It has an infinite range distance.

3- ***weak nuclear force***: responsible for radioactive decay, this short-range force is important for nuclear reactions in stars

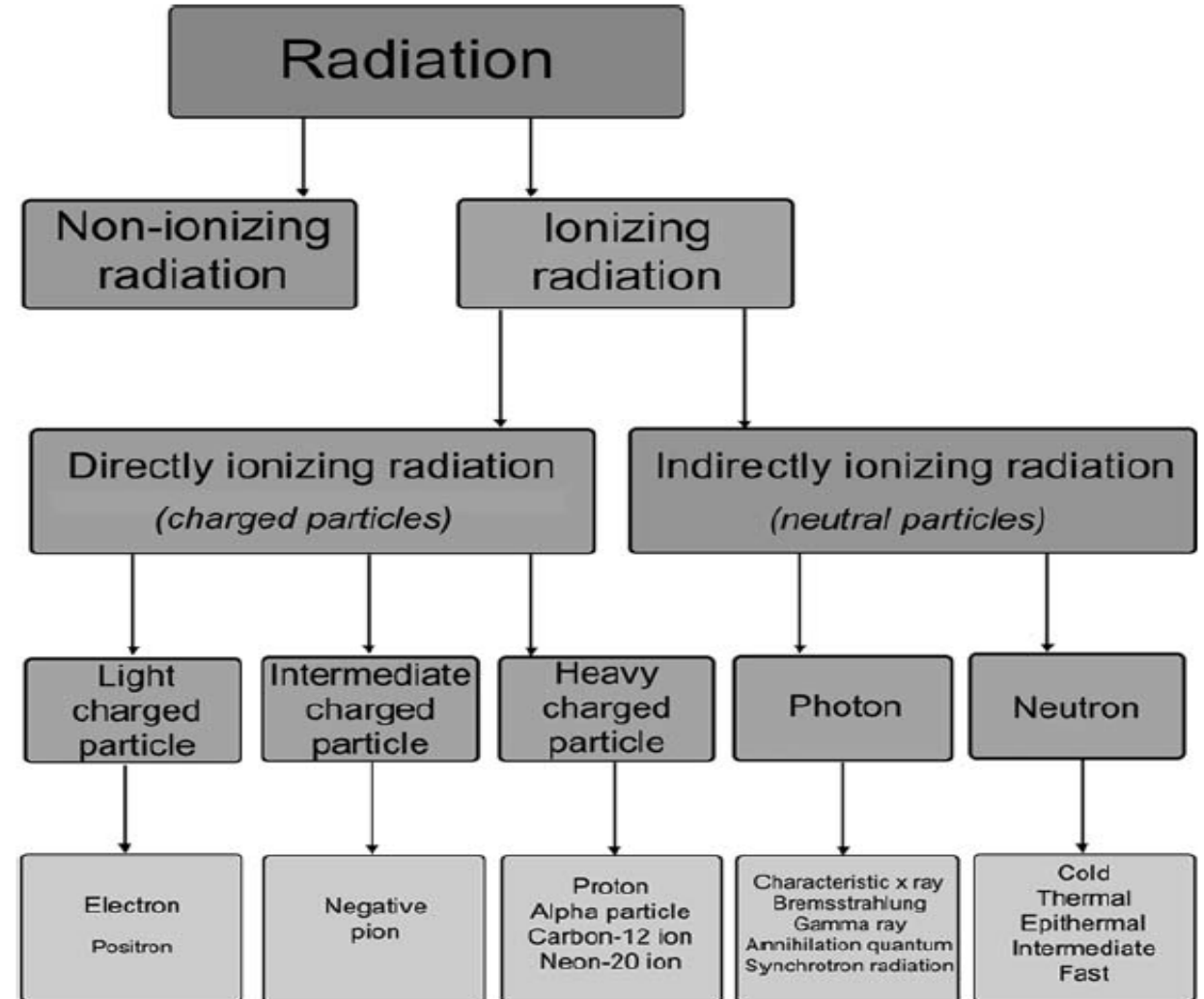
4- ***gravitational force***: a long-range force that acts between all objects with mass. It is always attractive and is the weakest of the four forces

Classification of Radiation

1- **Non-ionizing radiation** all types of electromagnetic radiation that cannot ionize matter because it does not carry enough energy to ionize atoms.

2- **Ionizing radiation** can ionize matter either directly or indirectly because its energy exceeds the ionization potential of atoms and molecules of the absorber.

Notice: Ionization is the physical or chemical process of converting neutral atoms or molecules into charged particles, known as ions, by gaining or losing electron.



Therapeutic Heating Modalities



- Heat therapy is useful in managing pain associated with various medical conditions such as arthritis, joint dysfunction, and injuries like sprains or strains.
- The use of heat also enhances circulation, reduces inflammation, and increases range of motion in joints and muscles.

Types of Heat Modalities Used in Physical Therapy

- 1- **Heating pads:** using superficial heat to stimulate blood flow.
- 2- **Paraffin baths:** soothing heat therapy used to increase relaxation and blood flow through superficial warming of the skin and underlying tissues by dipping a body part, such as the hand or foot, into a container of melted paraffin wax.

Therapeutic Heating Modalities



3- **Deep heating modalities**, such as therapeutic ultrasound or laser therapy, can help provide more targeted relief for conditions such as arthritis or tendonitis. Heat is delivered deep into the muscles and tissues, increasing blood flow to the affected area.

4- **Compression therapy**: by applying pressure to a specific area of the body that is affected, to improve circulation and reduce inflammation, leading to faster healing times and improved pain management

5- **Infrared therapy**: uses light to penetrate the body, warming deep tissues beneath the skin surface. The gentle warmth can boost blood circulation, improve muscle relaxation and recovery, and effectively reduce pain and inflammation in injured or affected areas

References

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